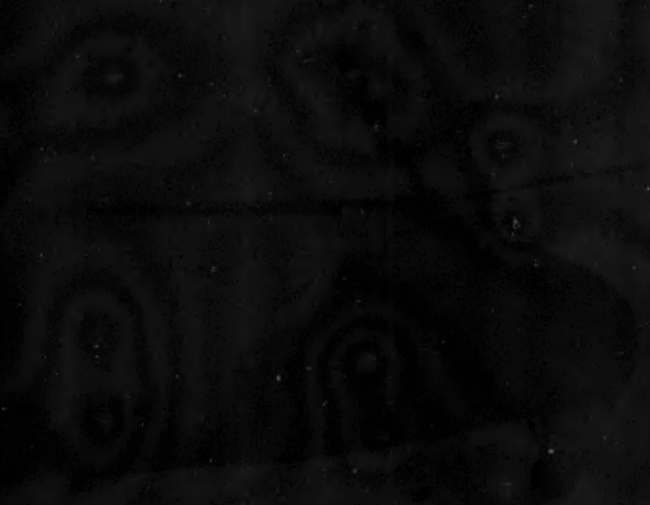
# ARMY AVIATION DIGEST



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JANUARY 1956 VOLUME 2 NUMBER 2

# ARMY AVIATION
## DIGEST

VOLUME 2 FEBRUARY, 1956 NUMBER 2

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**COVER: An H-34 lifts a 105 howitzer. Approximate weight of the gun is 4,550 pounds. The test, the first time a single-rotor helicopter has lifted a 105 howitzer, was recently cosponsored by the Army Aviation Unit Command and the Department of Tactics and Combined Arms, The Artillery and Guided Missile School, Fort Sill, Okla.**

**This copy is not for sale. It is intended for more than one reader.**

**PLEASE READ IT AND PASS IT ALONG**

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*Manuscripts, photographs, and other illustrations pertaining to the above subjects of interest to personnel concerned with Army aviation are invited. Direct communication is authorized to: Editor-in-Chief, ARMY AVIATION DIGEST, Army Aviation School, Fort Rucker, Alabama.*

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# THE COMMANDANT'S COLUMN

**Brigadier General Carl I. Hutton, *USA***
**Commanding General, The Army Aviation Center**

*The views expressed in this article are the author's and are not necessarily those of the Department of the Army.—The Editor*

## *The Age of the Offensive*

THIS IS ONE of the eras of the offensive. In those elements of warfare which combine great firepower and great speed, the offensive has every possible advantage over the defender. The cliche that the best defense is a good offense becomes literally true. The major nations are forced to plan on carrying the war to the enemy in order to defend themselves at all.

Needless to say, this is inherently an unstable condition. It fosters the arms race because the only possible defense is to build more and more offensive weapons. There is no apparent end except the final catastrophe of war. The situation resembles the armament race before World War I. It is true that the actual fighting in World War I proved the defensive to be much stronger than the offensive; but, during the preparation for the war, both sides *thought* the offensive would dominate the defensive. They prepared accordingly, and the arms race inevitably ended in war.

Conversely, those periods in which the defensive has proved stronger are relatively stable. The armament building contest tends to be self-limiting since the defender can always match the attacker by putting forth less effort. During the 1,000 years of the Middle Ages, the defense dominated the offense, and there were no major wars to engulf all of Europe.

What does the dominance of the offensive mean to the Army? When both sides possess great firepower alone, the situation tends to favor the defensive, since the attacker must come under fire as

he approaches the defensive position. It is the combination of firepower and speed which is decisive. The fortified zone becomes a minor obstacle if it can be by-passed or if the attacker can cross it very rapidly without coming under fire. If the land battle proceeds at the pace which has developed in the last 50 years, the defensive will become relatively meaningless because offensive weapons, such as missiles and trans-sonic aircraft, will simply move over or around the defensive position.

The Army's problem in this era of the offensive is to regain offensive capability. The firepower is available. Mobility needs to be added on a big enough scale to enable the Army in the field to penetrate defensive positions with great speed. Neutralization by firepower and extremely rapid exploitation would seem to be the answer.

The problem is technological. Fortunately, this is the area in which we feel ourselves to be strongest. Our industries can build the hardware we need.

---

## VOR Improvements

Through a new four-loop antenna array recently developed and evaluated at CAA's Technical Development and Evaluation Center, VOR course accuracy has been improved from the present operating tolerances of plus or minus 3.5 degrees to a tolerance of plus or minus 0.55 degree under near-normal conditions, according to CAA.

In a release announcing a program to improve the performance of VOR's, officials stated that conversion of all VOR antenna systems from the five-loop array to the four-loop array is scheduled for completion in the Fall of 1957. Some 65 conversions have already been completed, with 35 additional ranges in the process of changeover. In all, 406 VOR's will be converted, at a cost of approximately $900,000.

In addition to providing greater accuracy under all but exceptional conditions, the four-loop VOR's will present better indications on the cockpit instrument regardless of the attitude of the aircraft and will narrow the "cone of confusion" immediately over the station where no positive bearing information is possible, according to CAA. The four-loop array also provides a smoother transition on the "to-from" indicator, which shows whether the airplane is moving toward or away from the VOR station tuned.

# MIDAIR COLLISIONS

**Newton T. Saye**

*The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor*

WITHIN THE CONTINENTAL limits of the United States and its territories, 102 midair collisions involving civil aircraft took place between 1 Jan 1948 and 1 Jan 1955. Some of these also involved one or more military aircraft. Seven involved two Army aircraft.

What causes midair collisions?

Civil Aeronautics Administration files reveal that, during 1954, there were 14 midair collisions involving civil aircraft other than aircarriers. During the same year there were two midair collisions involving Army aircraft, making a total of 16 accidents. Of the 14 civil accidents, all occurred within a 5-mile radius of an airport. Eight were in the airport traffic pattern, with four occurring on final approach, one on the downwind leg and three on takeoff. The remaining six were either in-flight or cruising accidents within 5 miles of an airport.

Within this 5-mile area, what are some of the factors which could have caused these accidents? Weather conditions? Time of day? Traffic density? Cockpit visibility? Relative speeds? Conspicuousness of aircraft? Ground control? Physical condition of the pilot? John G. Screwball?

All 16 accidents, with the possible exception of one Army collision, occurred in clear weather and daylight. The Army collision, which might be an exception, occurred on final approach under a haze condition, but with visibility of over 3 miles. Time of day, likewise, appears to be no factor since the 16 covered the daylight clock. However, there were only two midair collisions at night in the period covered. Are pilots perhaps more careful at night, or is traffic density less? Ground control figured in only one of the 16,

and therefore appears to be a minimum factor. Two of the collisions were, without a doubt, the work of John G. Screwball, but this is a factor which can be controlled only through closer screening and, possibly, the science of genetics.

Density, at first consideration, might appear to be an important factor in that all 16 accidents occurred within 5 miles of an airport, while nine (over 56 percent) occurred in the airport traffic pattern. However, it is difficult to reconcile a density problem with these nine accidents because in each case, except one, the airport had no ground control and in all cases fewer than four aircraft were in the pattern at the time of the collision. The remaining seven, which were in-flight accidents, could be disregarded from the standpoint of aircraft density and attributed more to airport density. In no case were large numbers of aircraft in the area, and, in about half of the cases, the aircraft involved were many miles from their takeoff point. Actually, the only way density can be considered as a factor in these 16 example accidents is from the standpoint that increased density of aircraft in an area naturally increases the exposure factor in direct ratio.

Thus, by the process of elimination, we find that the four primary causes of midair collisions are probably cockpit visibility, relative speeds, aircraft conspicuousness, and physical condition of the pilot.

### *Cockpit Visibility*

Cockpit visibility, or lack of it, is possibly the heaviest contributor to the midair collision accident in clear weather, and remember that 90 percent of all collision accidents happen in clear weather.

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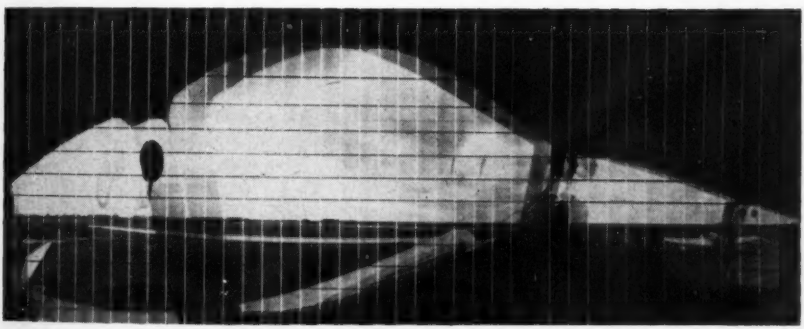
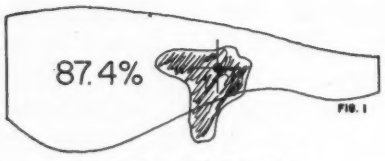
***Mr. Newton T. Saye*** *is an instructor in the Department of Fixed Wing Training, Army Aviation School, Fort Rucker, Ala. Mr. Saye soloed at the age of 16 and has been active in aviation ever since. He has logged more than 11,000 hours flying time in civilian, Navy, and Army aircraft, is instrument rated, and holds an airline transport pilot's license. From 1940 to 1952, he served as a CAA aviation safety inspector. Prior to joining the Army Aviation School instructor staff, he was employed as production engineer with the Monocoupe Aircraft Corporation. A veteran of 4 years active duty with the Navy, Mr. Saye holds a commission of lieutenant commander in the Naval Reserve and is the senior member of the instrument flight board of the Fighting 681st Reserve Squadron, U. S. Naval Air Station, Birmingham, Ala.—The Editor*

Having recognized this fact, in 1948 the CAA Technical Development and Evaluation Center at Indianapolis, Ind., made an investigation of the collision problem. Several lines of approach were used, the first being a questionnaire survey of 6,000 airline pilots. Conclusions reached from this survey indicated that present-day aircraft are, as a whole, completely inadequate from the standpoint of cockpit visibility. Pilots surveyed indicated that they considered from 0 degrees to 30 degrees to each side of the center of the pilot's seat to be the area most important to visibility, with the sector from 30 degrees to 60 degrees being the next most important. They indicated, also, that, because of their importance, these areas should be free of posts or other obstructions. Minimum downward visibility, the survey indicated, should be at least 8 degrees below the horizon during *straight climb* and at least up to the horizon plus 13 degrees in a *glide*. The airline pilots expressed little interest in having rearward visibility beyond 0 degrees to 135 degrees on each side. However, it is felt that in our slower type Army aircraft, the remaining 90-degree area is very critical and full 360-degree rearward visibility is thus very desirable.

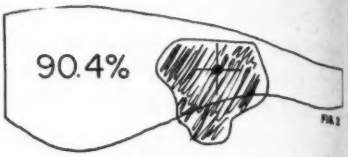
In 1950, after investigating several methods, the CAA developed a standard means for measuring cockpit visibility in which a camera with two lenses was set up to make a 360-degree sweep of the cockpit at the pilot's eye level. The lenses of the camera were so gridded and synchronized that photographs were divided into grids representing the number of degrees around the cockpit azimuth.



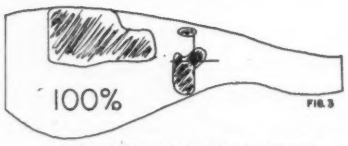
**Part of the standard method of measuring cockpit visibility developed by the CAA in 1950 is this grid system representing the number of degrees around the cockpit azimuth. A camera with two gridded and synchronized lenses was set up to make a 360-degree sweep of the cockpit. Photograph above shows gridded cockpit picture.**



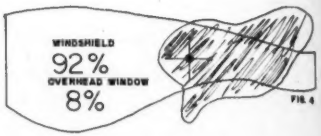

WINDSHIELD USAGE DURING
TAKE OFF TO AIRBORNE



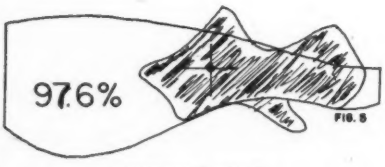

WINDSHIELD USAGE DURING
CLIMB TO 400 FEET



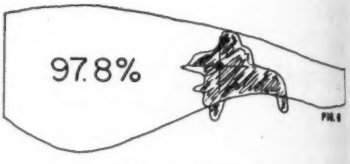

WINDSHIELD USAGE IN LEFT TURN




WINDSHIELD USAGE IN RIGHT TURN




WINDSHIELD USAGE
DURING DESCENT




WINDSHIELD USAGE
DURING FINAL TO TOUCHDOWN

**Usage of windshield during various critical phases of flight. Windshield area as illustrated above is one-half of the windshield design determined as ideal during the CAA query of 6,000 airline pilots.**

This grid pattern then produced a workable graph through which information concerning visibility could be interpreted. The next, and final, step, which was completed in mid-1952, undertook the actual photographing of the pilot's eye movement during different phases of flight. Mirrors and cameras were mounted in the cockpit of a transport aircraft, and photographs were made of the eye movements of 11 pilots. CAA researchers were able to read 35,817 of these photographs and to interpret them on the basis of the 360-degree graph.

The illustration above, the author's personal interpretation of data compiled during the CAA project, shows the portions of the cockpit windshield through which a pilot actually looks during

various phases of a flight. The windshield outline used is the one which the CAA pilot questionnaire revealed as the ideal. The crossed lines, or register mark, indicate "0" in front of the pilot's eyes.

These views can be interpreted to reveal several salient points about cockpit visibility and eye-movement patterns employed by pilots. First of all, with the ever-increasing number of aircraft using our airports and airways, it is evident that there is a definite need for increased cockpit vision. The ideal situation would place the pilot on the end of a boom extending forward from the nose of an aircraft with no cockpit enclosure to restrict his vision. However, the inadequacy of present-day windshields leaves considerable room for improvement well within practical limits of this "ideal."

The CAA study of eye-movement patterns also reveals pilot fault in the use of windshield areas available. The areas of the windshield he most often uses are ones required to obtain visual cues necessary to operate the aircraft rather than those through which he could search the air for other aircraft. For maximum visibility, especially during precipitation, the pilot's eyes should be close to the windshield and he should be seated in as narrow a cockpit as practicable. He is thus able to obtain maximum visibility with minimum head and body movement.

Midair collision obviously cannot be avoided by use of the windshield area alone since extreme visual angles may be required during many collision conditions. However, certain minimum visual angles in cockpit design will tend to decrease the probability of midair collision.

### *Relative Speeds and Conspicuousness*

Relative speeds of aircraft and their conspicuousness are closely related as factors in midair collisions. The human eye plays a part in these factors as well as in cockpit visibility.

Another CAA Technical Development and Evaluation Center study, the results of which were released late last year, produced two important conclusions regarding relative speed as a midair collision factor.

1. No apparent motion from the pilot's viewpoints exists between two aircraft which are flying straight and level on collision courses at constant speeds.
2. The most severe midair collision hazard from a visual-angle standpoint exists between aircraft that are flying at

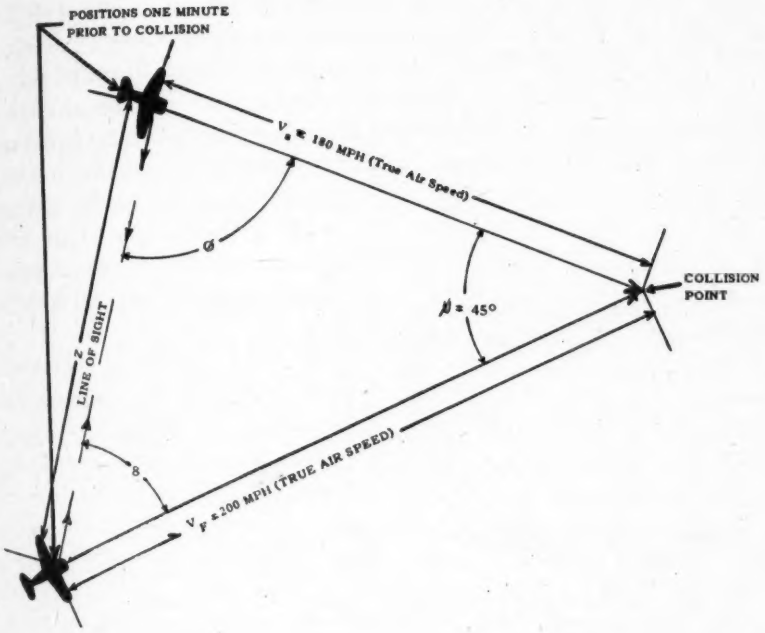
small differences of heading and speed. During this condition, even when the closing rates are small and much time is available for evasive maneuver, the visual-angle restrictions of present-day aircraft do not permit the pilots to observe each other.

In the 16 midair collisions occurring during 1954, several were accidents in which one airplane crashed into the tail of a similar, but slightly slower, airplane. Investigation revealed that in these accidents the pilot of the overtaking airplane had the other in full view; but, because of the failure of his eyes to detect the difference in relative motion of the two airplanes, collision occurred. This factor also accounts for almost all formation collisions. In many cases, pilots have reported after near-collisions that they observed the second aircraft for several minutes on a collision course before realizing that collision was imminent.

Remember that on a true collision course at the same elevation and in a straight and level flight no relative motion between the two airplanes is apparent. Therefore, if a sighted airplane holds a constant angle and reference in your line of vision, take evasive action. The vector diagram on page 11 illustrates a perfect collision situation starting 1 minute prior to collision between two aircraft of a relatively small speed difference. Once established on a 45-degree rate of closure, this rate of closure and the relative eye picture remain constant to collision.

The relative speed factor is particularly critical in concentrated training areas, such as Ozark Airfield at Fort Rucker, where large numbers of aircraft in the same approximate speed range converge for landings at the same time of day. This is a situation in which the straight and level type collision sets itself up so well. A contributing factor is that all Army aircraft, with the possible exception of the L-19, are very vulnerable from the rear. This vulnerability is graphically illustrated by the silhouette drawings on page 12. Note that the only blind spots with the L-19 are the areas away from the wingtips. The entire aft-wing area of both the L-20 and the L-23 is not visible to the pilot. In addition, each aircraft has an area of blindness at an angle with its engine or engines. All helicopters have extremely poor rearward vision angles.

A convex mirror recently developed by the CAA offers an economical partial remedy for this problem of poor rearward vision. Mounted in a bubble on top of the aircraft, the mirror affords the

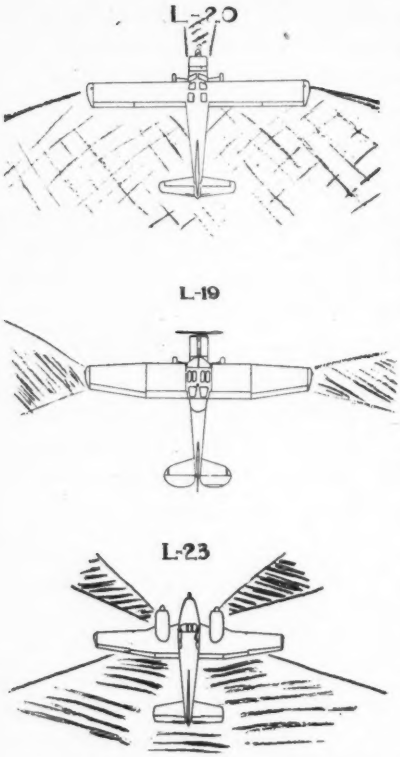



**Vector diagram illustrating "perfect" level-flight collision situation. If constant rate of closure is maintained, collision is inevitable. At the same time, the relative eye picture of the slower aircraft remains the same to collision.**

pilot a full view above and behind him. Installation of this, or a comparable device, in Army aircraft, particularly those used for instrument training, would do much to alleviate restricted rearward visibility.

Straight climb and descent collisions are governed by exactly the same factors and conditions as collisions in straight and level flight. Collision in turns usually is a factor directly related to cockpit visibility and conspicuousness. That is, in a turn toward another airplane on a collision course, the airplane is usually obscured from the pilot's view by some structural characteristic of the turning airplane.

Conspicuousness of a particular airplane in flight is an important factor in midair collisions, but one which, for the present, can




**Individual diagrams illustrating rearward vulnerability of the three most widely used Army aircraft. Shaded areas show blind spots, which are extensive in both the L-20 and the L-23.**

only be reckoned with rather than alleviated in most instances. The Army Aviation Center has made significant progress toward solving this problem in local areas through painting training aircraft international orange, a vivid tone which, under most conditions, has extreme contrast with the sky. This move has increased the conspicuousness of Center aircraft several hundred fold.

The CAA recently received a 5-year authority for experimentation with safety devices which will increase aircraft conspicuousness. The convex mirror device is one of these; a second is a rotating red beacon light to be mounted on the top of fuselages. This latter device will be required by law on all aircraft of over 12,500-pound gross weight, as of 1 June 1956. Another device developed thus far by the CAA is an electrical discharge system mounted along the side of an airplane which will produce a bar of light the length of the fuselage. Other devices still in the experimental stage include rotor-tip lights for night illumination of helicopters and electronic proximity warning indicators.

### *Physical Condition of Pilots*

Flight surgeons continually emphasize the fact that a pilot's state of mind directly affects his judgment. This is a fact which has been borne out in innumerable research projects and in many actual accident situations. Yet, as working pilots, we may tend to minimize its importance and grow to accept minor physical or emotional

stresses as occupational hazards. This willingness to get the job done can, of course, be carried too far for your own and others' safety. An experienced pilot knows when he is close to the "grounding" point, and the wise pilot admits it when that time comes. On those days, when family, financial, or other worries beset you more than usual or when you feel below par physically, a trip to the flight surgeon and a day on the ground may circumvent a potential midair collision situation.

### *Conclusion*

It should be remembered that 91 percent of all midair collisions occur in clear weather, covering all periods of the daylight clock. Midair collisions rarely occur at night. The most dangerous phase of flight is final approach. There is no evidence that ground control, weather conditions, or time of day are significant factors in the midair collision. Density, aircraft or airport, appears to be a factor only in that it increases exposure. The primary causes of midair collisions are limited cockpit visibility, relative speeds and conspicuousness of the aircraft, and the physical conditions of the pilots. Lack of cockpit visibility contributes to more midair collisions than any other factor. Relative speeds and conspicuousness of aircraft are the second greatest contributors and are closely related in their affect on the potential midair collision situation. Physical condition of the pilot directly affects his alertness to any collision potential. John G. Screwball is, of course, still with us and sometimes figures in the midair collision, but the pilot's greatest protection against this factor is simply not to be one.

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Twenty-one H-34's of the 506th Helicopter Company, Fort Benning, Ga., completed 329 assigned flights and logged 38,267 air miles during Exercise Sage Brush, in which the H-34 saw initial operational duty with the Army. Between 11 November and 8 December, the aircraft were used to transport 852 personnel and lift 315 tons of cargo. Missions included blood bank lifts and assault transportation of troops, vehicles, ammunition, food, water, and medicine. In one operation, 464 simulated casualties were evacuated in 3½ hours.

## Arctic Operation

THE ARMY'S TRANSPORTATION Arctic Group, with headquarters at Thule Air Base, Greenland, recently pioneered a first for Army aviation in the Arctic.

The Group, a special unit of the Transportation Corps, is primarily engaged in research and development activities in connection with surface transportation in the Arctic. In support of surface operations, it maintains organizational helicopters and light fixed-wing aircraft.

The Aviation Section provides reconnaissance, emergency passenger and freight transportation, and routine transportation to locations inaccessible by surface transportation. It also provides high-speed transportation for personnel engaged in making scientific observations at a number of points on the icecap.

Captain Robert J. St. Aubin, Group Aviation Officer, recently led a flight of two L-20's and two H-19D's to an icecap station far out from Thule Air Base. This was the first time either type of Army aircraft had ventured so far out on the icecap. Both types of aircraft landed and took off without difficulty at an altitude in excess of 7,000 feet, which is believed to be a record in Greenland for this size aircraft. Purpose of the flight was to determine the feasibility of Army aircraft support to ground parties at extended distances and high altitudes.

Following the flight, Group Commander Colonel Page H. Slaughter, said: "This proves to me that we can support our ground parties at greater distances than we had planned. We will continue caching aviation fuel at more extended distances on the icecap and, thus, greatly increase the radius of air support we can provide to our Army personnel. It is certainly most economical to handle light emergency airlift requirements with Army aircraft. Moreover, it is mighty interesting to learn that we can operate at altitudes we previously thought were impracticable. This may also increase the area in which Army aircraft support is feasible."

As a result of this flight, aviation fuel is being added to many caches the Transportation Arctic Group has already established on the icecap. Further experimental flights will be made to determine the actual, rather than theoretical, capabilities of Army aircraft in support of surface operations on the Greenland icecap.

# XH-40

THE DEPARTMENT of Defense, in its announcement of award following the Army's utility helicopter design competition, described Bell's XH-40 as "a lightweight, closed cabin, single rotor helicopter capable of carrying at least 800 pounds, cruising at 100 knots, hovering at 6,000 feet or more, and climbing at a rate of more than 1,500 feet per minute." Bell Aircraft presented its full-scale model (above, without main rotor blades installed) to the Mock-up Inspection Board and other military observers and advisors 3 months ahead of schedule. The XT-53, Avco's Lycoming free-power gas turbine engine, has been selected to power the XH-40. The new design is expected to provide the Army with a faster, larger, and more powerful utility helicopter for frontline medical evacuation, general utility missions, and rotary-wing instrument training.

The six-place, closed-cabin XH-40 incorporates many new design features, including the free-power turbine engine, all-metal rotor blades, and a new rotor hub design, which Bell officials say will result in significant savings in weight, wear, and maintenance time. All major components are arranged for easy replacement and repair in the field without the use of special tools.

Translated into performance, Bell engineers anticipate a 35 per cent empty weight reduction, a 100 per cent increase in payload, and a 43 per cent increase in cruise speed as compared to similar reciprocal-engine-driven utility helicopters presently in use. Capable

of a vertical climb rate of 1,900 fpm from sea level, according to Bell releases, the XH-40 is expected to attain a better than 15,000-foot hovering ceiling out of ground effect on a standard day and a 7,000-foot hovering ceiling out of ground effect on a 95-degree day, both at gross weight. Range is in the 200-nautical-mile class with full payload.

Avco's Lycoming XT-53, one of the major advancements offered by the XH-40, is the first free-power turbine designed for helicopter and Army use. The XT-53 engine was designed by Dr. Anselm Franz, German designer of the first mass-produced jet engine and, like his oo4, which powered Germany's Messerschmitt 262 in 1944-45, it breaks new ground as far as aircraft power is concerned. Often described as the "workhorse" engine, the XT-53 is designed

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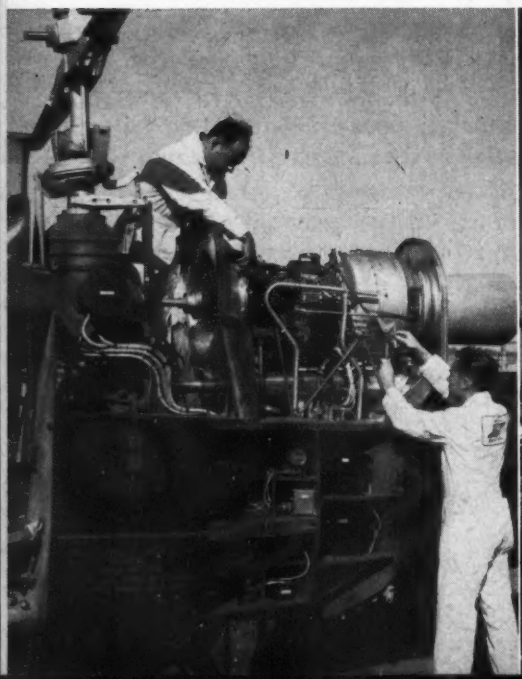
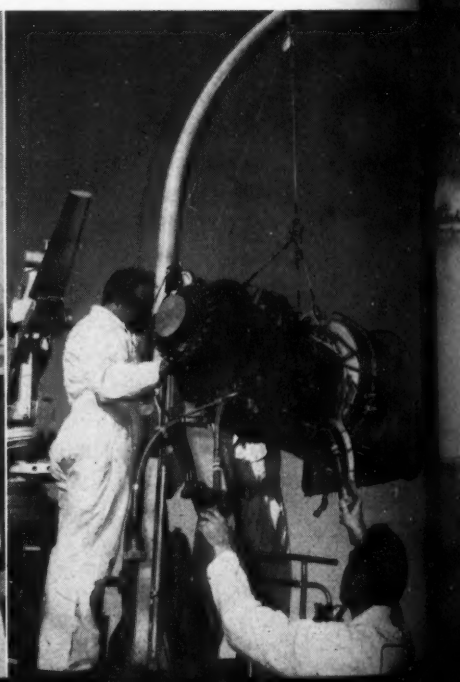
*This article was prepared by the ARMY AVIATION DIGEST staff. Views expressed are not necessarily those of the Department of the Army or of The Army Aviation School. —The Editor*

**According to Bell officials, all major components of the XH-40 are arranged for easy replacement and repair in the field without the use of special tools. Built-in work platforms, hub wrench, and portable hoist also facilitate maintenance. At left, mechanics perform maintenance from built-in platform and from ground level. The latter is made possible by pump-down skid wheels which tilt the XH-40 backwards. Right, the XT-53, free-power gas turbine engine, is suspended from the portable hoist. Bell engineers anticipate that the XH-40 will have 1,000-hour flight periods between major overhauls.**





The XH-40's closed cabin is readily adaptable to several operation configurations. The maximum personnel load (shown above) is four passengers, pilot, and copilot. For reconnaissance/observation missions, the cabin arrangement allows for three passengers and a planning map table, plus pilot and copilot. Canvas seats, supports, and table are stowed within the helicopter for all-cargo flights. For medical evacuation (below), the XH-40 cabin can accommodate two litter patients and a medical attendant along with pilot and copilot. Simultaneous litter loading from both sides through sliding doors can be accomplished in 15 seconds.

**XH-40 compared with H-13. The low silhouette and compact configuration of the new model compare favorably with the smaller helicopter despite the fact that it has twice the personnel capacity, all inside the cabin, and a larger, though more powerful, engine.**

for both fixed-wing and rotary-wing use. The helicopter version is rated as 825 hp for military power and 770 hp for maximum power. On the XH-40, it will operate similar to the engine of a turbo-prop airplane, turning the main rotar rather than propellers. All turbo-prop engines previously designed in this country drive at least part of the bank of compressor wheels in addition to the propeller. In the XT-53, however, the turbine and shaft that turn the rotor operate independently from the turbine and shaft that drive the compressors. The speeds of the two turbines thus can be varied in any number of combinations, and, in addition, full power of the turbine is available for driving the main rotor.

The free-power principle eliminates the need for a clutch. Additionally the turbine engines eliminate fans, spark plugs, and reciprocating parts, resulting in appreciable maintenance savings. Another advantage is that the turbine can operate on a wide range of fuels, including JP-4, all-purpose automotive, aviation, and kerosene. Spark plug fouling, a common problem when high octane fuel is not available in forward areas, as was sometimes the case in Korea, will not exist with the XH-40.

The XH-40 is the first helicopter to provide in-flight blade tracking, thus eliminating mechanical adjustments on the ground to track and trim rotor blades, according to Bell. The pilot's instrument panel is also equipped with night-flying equipment and provisions for all-weather instruments.

# TORQUE WRENCH TECHNIQUE

**John P. Parker**

*The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor*

THE PROPER USE OF A TORQUE wrench is a procedural skill which cannot be over emphasized in aviation maintenance. The following instructions on proper torquing methods are offered for the information and guidance of all personnel engaged in the maintenance of Army aircraft.

A bolt can be considered as a steel shaft with threads at one end and a method of turning it at the other. Actually, it is a deluxe nail. A torque wrench is a "pair of steel fingers" with a handle for leverage and a meter which measures the magnitude of the applied leverage. The torque wrench is the tool used to "drive" this deluxe nail.

Before you can apply torque to any bolt, you must know the torque value for the particular bolt, and, unless your memory parallels that of an elephant, you need to keep your maintenance handbook within easy reach. Torque wrenches are of no value whatever unless you know how many pounds of torque to apply on a particular piece of work. So, keep that handbook near.

When starting an important and expensive job, it is advisable to have your torque wrench calibrated before you start the job. Then have it calibrated after the job is completed to be sure that you have applied the right torque value to every bolt and nut.

Undertorquing can only result in loose joints. This is especially true when vibration in one form or another is present. The type of vibration experienced on rotary-wing aircraft is a good example of such vibration. Correct torque will *increase* the fatigue life of any component since the preload is equal to or greater than the alternating load imposed. In other words, the joint is rigid enough to prevent vibration and a reversal of stress, which cause metal fatigue failure.

Now, let us refer to table A. Note that this table is set up for nuts only. It is not practical to set up an overall table for bolts since there are so many variables. The torque values in this table are given in inch-pounds, but the table is easily converted to foot-pounds by dividing the given value by 12. Individual instances may arise where it is impossible to tighten a fastener by rotating the nut. In this case, it is advisable to use the applicable maximum allowable tightening torque (columns 2 and 3) when turning the bolt head.

The values shown in table A may be used for all cadmium-plated steel nuts. These values were determined with the normal friction of the threads and the surface of the nut on the work. Tightening to a given torque value with threads lubricated results in over-stress. However, it is permissible to use anti-seize compound *sparingly* in applications so specified in the applicable maintenance handbook. Again, let us refer to table A:

(1) Tension-type nuts, installed on standard bolts, studs, and screws which have a tensile strength of 125,000-140,000 psi, should be torqued to within the values shown in column 2.

(2) Shear-type nuts, installed on standard bolts, studs, and screws having a tensile strength of 125,000-140,000 psi, should be tightened to within the torque values listed in column 3.

(3) Nuts installed on high-tensile strength bolts, studs, and screws having a tensile strength of 160,000 psi or greater should be tightened to the torque values shown in column 4. *However, if shear-type nuts are used on high strength fasteners, you must use the torque values for shear-type nuts.*

(4) Columns 5 and 6 list maximum allowable tightening torques. These torque values are intended primarily for bolts

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***Mr. John P. Parker*** *is the Chief of the Air Section (Common Tools), Tools and Equipment Branch, Director of Maintenance, Transportation Corps Supply and Maintenance Command, 12th and Spruce Streets, St. Louis 2, Mo. He is a graduate of Parks College of Aeronautical Technology, from which he received his BS degree in aviation maintenance engineering. He is also a graduate of the Army Aviation Mechanics School, the Pilot Training School, and the Army Auto Maintenance and Repair Officer's School. During World War II, from 1942 through 1943 he served as a fighter pilot. From 1943 through 1945, he was a German prisoner of war. He is an active member of the Air Force Reserve and current in the B-26 light bomber.—The Editor*

| | BOLT, STUD, OR SCREW SIZE | STANDARD NUTS, BOLTS, AND SCREWS | | HIGH-STRENGTH NUTS, BOLTS, AND SCREWS | MAXIMUM ALLOWABLE TIGHTENING TORQUE | |
|---|---|---|---|---|---|---|
| | | TENSION-TYPE NUTS AN310 and AN365 (40,000 psi in bolt) | SHEAR-TYPE NUTS AN320 and AN364 (60% of column 2) | ANY NUT EXCEPT SHEAR TYPE | TENSION-TYPE NUTS AN310 and AN365 (90,000 psi in bolt) | SHEAR-TYPE NUTS AN320 and AN364 (60% of column 5) |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| FINE THREAD | 8–36 | 12–15 | 7–9 | 15–18 | 20 | 12 |
| | 10–32 | 20–25 | 12–15 | 23–35 | 40 | 25 |
| | 1/4–28 | 50–70 | 30–40 | 70–90 | 100 | 60 |
| | 5/16–24 | 100–140 | 60–85 | 140–203 | 225 | 140 |
| | 3/8–24 | 160–190 | 95–110 | 190–351 | 390 | 240 |
| | 7/16–20 | 450–500 | 270–300 | 500–756 | 840 | 500 |
| | 1/2–20 | 480–690 | 290–410 | 690–990 | 1,100 | 660 |
| | 9/16–18 | 800–1,000 | 480–600 | 1,000–1,440 | 1,600 | 960 |
| | 5/8–18 | 1,100–1,300 | 660–780 | 1,300–2,160 | 2,400 | 1,400 |
| | 3/4–16 | 2,300–2,500 | 1,300–1,500 | 2,500–4,500 | 5,000 | 3,000 |
| | 7/8–14 | 2,500–3,000 | 1,500–1,800 | 3,000–6,300 | 7,000 | 4,200 |
| | 1–14 | 3,700–5,500 | 2,200–3,300 | 5,500–9,000 | 10,000 | 6,000 |
| | 1 1/8–12 | 5,000–7,000 | 3,000–4,200 | 7,000–13,500 | 15,000 | 9,000 |
| | 1 1/4–12 | 9,000–11,000 | 5,400–6,600 | 11,000–22,500 | 25,000 | 15,000 |
| COARSE THREAD | 8–32 | 12–15 | 7–9 | 15–18 | 20 | 12 |
| | 10–24 | 20–25 | 12–15 | 25–35 | 35 | 21 |
| | 1/4–20 | 40–50 | 25–30 | 50–68 | 75 | 45 |
| | 5/16–18 | 80–90 | 48–55 | 90–144 | 160 | 100 |
| | 3/8–16 | 160–185 | 95–110 | 185–248 | 275 | 170 |
| | 7/16–14 | 235–255 | 140–155 | 255–428 | 475 | 280 |
| | 1/2–13 | 400–480 | 240–290 | 480–792 | 880 | 520 |
| | 9/16–12 | 500–700 | 300–420 | 700–990 | 1,100 | 650 |
| | 5/8–11 | 700–900 | 420–540 | 900–1,350 | 1,500 | 900 |
| | 3/4–10 | 1,150–1,600 | 700–950 | 1,600–2,250 | 2,500 | 1,500 |
| | 7/8–9 | 2,200–3,000 | 1,300–1,800 | 3,000–4,140 | 4,600 | 2,700 |
| | 1–8 | 3,700–5,000 | 2,200–3,000 | 5,000–6,840 | 7,600 | 4,500 |
| | 1 1/8–8 | 5,500–6,500 | 3,300–4,000 | 6,500–10,800 | 12,000 | 7,200 |
| | 1 1/4–8 | 6,500–8,000 | 4,000–5,000 | 8,000–14,000 | 16,000 | 10,000 |

**Table A. Torque values in inch-pounds**

loaded in tension. The values in column 5 develop approximately 90,000 psi in the bolt; those in column 6, approximately 54,000 psi. Nuts must not be tightened in excess of the values shown in these columns.

*CAUTION: In the event there is any conflict between table A and the applicable "—2" Handbook, the values shown in the handbook will prevail.*

The following threaded parts must be 100 percent inspected for torque: (1) parts with a tensile strength of 160,000 psi or more, (2) parts where torque values are specified in the maintenance handbook or in the drawing, and (3) parts where magnetic inspection is specified in the maintenance handbook or in the drawing.

In some instances special torque values must be used. Some bolts, for example, must *not* be torqued to the values shown in the table. If in doubt about the proper torque value, look it up in the maintenance handbook. Table A is to be used when no torque value is given in the handbook.

Joints which have been sealed with synthetic rubber sheet or gasket material require a special set of torque values. Unless otherwise indicated in the maintenance handbook, the following values must be used:

| ***Fastener Size*** | ***Torque in Inch-Pounds*** |
|---|---|
| No. 10 | 20-25 |
| 1/4 | 25-50 |
| 5/16 | 35-60 |

A straight drive-end extension does not change the leverage capacity of an adjustable limiting-type wrench. But if you use an offset drive-end extension, the influence of the offset on the effective length of the wrench must be taken into consideration. The Plomb Tool Company, Los Angeles, Calif., gives the following formula for computing this change in their break-away torque wrenches: Measure the adapter from the centerline of the square drive to the centerline of the socket. Multiply this length by the constant factor shown in table B. Most manufacturers furnish a similar table for computing the effect of adapters on their wrenches.

For example, say that we are to use an 11-inch offset extension on a typical torque limiting wrench to obtain a 5000 inch-pound reading. If the wrench is preset at 2609 inch-pounds, we multiply this setting by the factor as given for the 11-inch adapter (table B).

| *Extension* | *Multiply Torque Reading By* | *Extension* | *Multiply Torque Reading By* |
|---|---|---|---|
| 1 inch | 1.0833 | 7 inch | 1.5833 |
| 2 inch | 1.1666 | 8 inch | 1.666 |
| 3 inch | 1.25 | 9 inch | 1.75 |
| 4 inch | 1.333 | 10 inch | 1.833 |
| 5 inch | 1.4166 | 11 inch | 1.9166 |
| 6 inch | 1.5 | 12 inch | 2.00 |

*This table was developed by the Plomb Tool Company, Los Angeles, Calif., for use with that company's torque limiting break-away wrenches.

**Table B*. Constant factors for use in computing adapters.**

We get 5000.4 inch-pounds, which would be the actual torque applied at the end of the adapter. This formula can be reversed by *dividing* 5000 inch-pounds by the factor 1.916. We get 2609 inch-pounds, or the torque wrench setting (reading) required to obtain a load of 5000 inch-pounds at the end of the adapter.

If a *handle* extension is used on the adjustable limiting-type wrench, no computation is necessary because the extension does not actually change the effective length of the wrench. However, if the proper size torque wrench is used, no extension will be necessary. Always try to use the wrench designated for the specific torque requirement.

Never use a torque wrench to back off a nut or bolt, but treat it like the fine mechanism it is. When the wrench is not in use, keep it in a safe, dry place where it will not be knocked around by other heavy tools. Keep your torque wrench clean and free from dirt and be sure to have it calibrated regularly. Remember, the right torque value for a particular fastener gives you maximum tensile strength, which contributes to maximum maintenance security. Always use your torque wrench wisely, and you will be doing your part in contributing to safety on the ground and in the air.

# UER HIGHLIGHTS

**Major Fred R. Reed, *Transportation Corps***

*The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor*

IF THIS MONTH'S column heading of "UER Highlights," instead of "UR Highlights," has you wondering, get a copy of AR 700-38, dated 1 November 1955. This is the new regulation that supersedes SR 700-45-5. As there are several changes in the new regulation governing the Unsatisfactory Equipment Report program, we will take a few paragraphs to "highlight" this publication.

The importance of the new regulation is clearly established in paragraph 1, which reads as follows:

> These regulations establish uniform procedures for reporting deficiencies in design and manufacture of all equipment and material used by the Army, except ammunition and drugs and biologicals, to permit prompt correction of such deficiencies, to insure prompt change of technical instructions, or to prevent further issue of defective items or parts.

The keyword of the foregoing paragraph is "prompt." As has been stated previously, prompt corrective action will be possible only if prompt reporting of unsatisfactory conditions is made by the field.

Paragraph 3 of the new regulation assigns the responsibility for submission. This paragraph directs that the individual in charge of the organization or activity at which a reportable deficiency is detected is responsible for submission of a complete report on that deficiency. This portion of the regulation makes it possible for military personnel, civilian personnel, or other persons in any way connected with the equipment involved, either under contract or otherwise, to submit reports through the individual in charge of the organization or activity. This opens the field wide to everyone. The responsibility, however, remains with the individual in charge.

UER reporting, then, is a command responsibility. The commander, or supervisor, must aid and encourage all personnel to be alert to detect deficiencies and report them. It is recommended that each commander, at any level, establish a control system so that he knows at all times the effectiveness of the UER program.

Section II of the regulation establishes the procedures applicable to Transportation air items. There is one change that should encourage personnel in the field. UER's will be submitted in duplicate only. They will be submitted to the *supporting field maintenance activity*. The field maintenance activity, after adding any information available on the reported condition, will forward one copy direct to Transportation Supply and Maintenance Command. No more six copies!

Paragraph 12 covers the actual preparation of the report. Pay particular attention to this portion of the directive. It is as important to maintain the quality of UER's as it is to maintain quantity.

To accomplish its purpose, the UER must provide enough information to assist the engineers and technicians in making their evaluation.

The new regulation directs the use of a different form for Department of the Army use. It is the revised DA Form 468, Unsatisfactory Equipment Report. Whether we choose to call it a "UR" or a "UER" is immaterial. The important thing is to submit them promptly and properly.

For "highlighting" this month, the following reported conditions have been selected.

## *Fixed Wing*

**Problem:** Rudder Hinge Cracking, L-23.

UER's reported that the lower rudder hinge assembly, part number 50-524023-2, was breaking where the bearing is staked into the hinge. In addition, the rudder cable pulley bracket, located just aft of the rubber bellcrank, has been buckling to the extent that the pulleys were binding. Upon investigation, it was found that improper adjustment of the rudder bellcrank stops and rudder pedal

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***The UER Highlights Department,*** *prepared by Major Fred R. Reed, is compiled from information contained in Unsatisfactory Equipment Reports received by the Transportation Corps Supply and Maintenance Command, 12th and Spruce Streets, St. Louis 2, Mo. Major Reed is Chief of TSMC's Publication Division.—The Editor*

bellcrank stops was the primary cause. A technical bulletin, TB AVN 20-4, dated 7 November 1955, has been published pertaining to this discrepancy. This technical bulletin recommends that all L-23's be inspected to insure that the rudder bellcrank and rudder pedal bellcrank are rigged to strike their respective stops simultaneously. The procedures for adjusting may be found on pages 35-38, TO IL-23-2, 1 December 1952, revised 25 May 1955.

### *Rotary Wing*

**Problem:** Tail Rotor Gearbox Filings, H-13.

A good many UER's have been received reporting metal particles being found in the tail rotor gearbox oil system. Disassembly inspection reports reveal various causes for these metal particles:

1. Failure of the manufacturer to install retainer ring.
2. Improper assembly.
3. Failure to properly clean gearbox after removal of brass plug.
4. Proper gearbox oil level not maintained.

There are many other reasons why metal particles might be found, including an improper gear pattern or a worn bearing. This command will try to isolate the cause for metal particles in each case reported. In regard to the four reasons given, contractor and overhaul facilities have taken corrective action on the first two. The remaining items depend upon personnel in the field for correction.

The first one, failure to properly clean gearbox after removal of the brass plug, does not mean that every time the plug is removed the gearbox must be drained and flushed. However, the plug should be minutely examined for any evidence of portions or particles of the plug missing. Should this examination reveal portions or particles missing, it is a logical assumption that these missing particles are inside the gearbox, and common sense tells us to drain and thoroughly flush it. But is this enough? Not necessarily. If there is any doubt in your mind as to whether or not particles remain in that gearbox, remove it and install a new one!

The second field item, improper lubricant level, is easily corrected and shouldn't exist in the first place. The "—2" handbook requires a daily check, with a change every 120 hours. The "—2" directs a daily check but, at the same time, does not prevent more frequent checks if conditions warrant. We might as well face it.

No machinery operates efficiently when it is dirty and not lubricated properly. We know we don't have to remind you that, when that piece of machinery, the airplane, does not operate efficiently, it can be a *long way down.*

**Problem:** Snubber Damper Assembly Failure, H-25.

The many UER's received on this condition have resulted in a new snubber and damper assembly design that is presently being tested. Included in the new design are the following changes:

1. Two piston rings to reduce the sensitivity of the damper side load and damper load characteristics to wear.
2. A spring-loaded oil circulating valve to automatically dispel air from the unit.
3. The addition of a filler cap incorporating an air reservoir to provide for field filling. This will permit raising the oil level and will reduce the damper sensitivity due to oil seepage and pumping of air into the damper when the rotor is stationary.
4. A modified snubber cap to provide a floating attachment.

## *Power Plants*

**Problem:** Piston Failures, O-335-5-6.

Investigation of the many reported failures revealed that the piston damage was due primarily to the following conditions:

1. Deterioration due to excessively high operating temperatures.
2. Operating with excessively lean mixture settings.

Three changes being incorporated at time of overhaul should result in better operation and extension of the overhaul period:

1. A new type piston having a cast iron insert at the top ring groove that provides negligible wear between the piston and the top piston ring.
2. A new redesigned intake manifold.
3. Sodium-cooled exhaust valves.

You will note that we say the modifications indicated above *should* provide for better operation and extend the overhaul period.

*(Continued on page 30)*

# BOOKS

## For The Army Aviator

**THE FIRST AND THE LAST**—*Galland, Adolf (Henry Holt and Company, Inc., 257 Fourth Ave., New York 10, N. Y., 1954. $4.95)*

Galland entered WWII "as lieutenant and flight captain" in an ME-109 squadron, and he ended it "as lieutenant general and flight captain" of ME-262 jet fighters. This book is his story—with a fair minimum of bragging—of his 100 aerial victories which earned him promotion as General of the Fighter Arm of the Luftwaffe and of the continuing fight he waged in the latter capacity to have the fighter forces employed as he believed they should be.

His fundamental thesis is that the Luftwaffe was misemployed consistently beginning with the Battle of Britain and throughout the rest of the war. This was especially true of the fighter forces, which, he writes, were neglected until too late and had their offensive verve blunted by rigid and erring operational concepts. The failure of the Luftwaffe during the daylight phase of the Battle of Britain arose from the extremely limited range of the fighters. Their radius of 125 miles covered about one-tenth of England. The bombers were unable to defend themselves beyond this range, and consequently the English were able to repair and refit the RAF fighters in the nine-tenths of the country which was untouched.

Germany surrendered the advantage she had won in the development of jet aircraft through two factors. First was the obsession which held Hitler in a viselike grip that the end of the war was always just around the corner. He therefore attached little importance to aircraft he believed would not be ready for combat until after the war was over. Second was Hitler's insistence that the ME-262

fighters be used as fighter-bombers to attack troops on the ground rather than as defensive weapons against the American mass raids.

This book is very easy to read and certainly interesting, especially to those who can remember something of their own feelings on the other side of the hill at the same time. One strong impression remains. There is not one word in the book which suggests that war is not other than a usual and normal state of affairs. This is a contrast to the well-remembered feeling among our own fighting forces that war is utter folly but as long as we are at it we should fight it to the best of our ability.

**THE PSYCHOLOGY OF FLIGHT**—*Varney, Alex (D. Van Nostrand Company, Inc., 250 Fourth Ave., New York 3, N. Y., 1950. $4.75)*

Pilots, student pilots, flight instructors, and aviation medicine personnel will find this book on man's behavior as he learns to travel in the third element, the air, both interesting and informative. An early experience during which a seemingly competent and calm student pilot suddenly froze at the controls led the author to study the psychology of flight. From teaching experience dating from the post WWI period, he has gathered practical information on the emotional and psychological factors that condition human response to airborne movement.

The late General H. H. Arnold wrote, after reading Mr. Varney's book, "the manuscript is intensely interesting, but I do not know whether it is psychology, or just common sense, or both." This opinion reflects the practical and human approach taken by the author in his discussion of such factors as why pilots behave as they do, learning to relax and to coordinate, developing reflexes, and building confidence and judgment.

Mr. Varney's realistic treatment of pilot adjustment to the kind of experiences that are never met within land or water transport should be appreciated by the experienced pilot as well as the instructor and the student pilot. His discussions are practical and helpful, and the reader can readily understand how they apply to his own problems.

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*Book reviews are compiled by the ARMY AVIATION DIGEST staff. Views expressed are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor*

**ELECTRO-MAGNETIC MACHINES** — *Langlois-Berthelot, R. (Philosophical Library, Inc., 15 E. Fortieth St., New York 16, N. Y., 1950. $15.00)*

A reference book by the chief research engineer and director of one of the most modern and best equipped high-voltage laboratories in Europe, this book emphasizes fundamental principles concerning transformers and rotating machines. Organizing his material into six parts, the author covers the various families of transformers and rotating machines, their general composition and operation, problems of design and construction to fulfill specified conditions, and problems of the engineer in defining their working conditions. The theory of abnormal conditions, such as harmonics, unbalance, and transients, and various ideas of flux, reactive power, and industrial research are discussed. For the reader unacquainted with electro-magnetic machines, answers to some of the elementary considerations are also provided in an appendix.

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*(UER HIGHLIGHTS continued from page 27)*

We have received two UER's reporting burnt, cracked exhaust valves on the modified engines. This is being investigated.

**Problem:** Rocker Box Drain Line, R-975-46.

The manufacturer advises that a stainless steel drain tube is being cut between number 6 and number 7 cylinder, and that an extra support bracket is being installed on number 6. The manufacturer considers this a minor repair and not a modification. This command, however, considers it a modification and has furnished the Air Force with the necessary information for review and possible issuance of a technical order to rework all 975 engines installed on H-25 helicopters. A test was conducted, and it was found that, as an interim measure, applying a torque of 150-180 inch-pounds to the flood control adapters reduced the number of discrepancies.

In closing, we urgently recommend that every unit that has anything to do with aircraft insure that there is a copy of AR 700-38 available. Further, commanders and supervisors at all levels should become thoroughly familiar with the regulation and encourage and assist their personnel in detecting and reporting discrepancies.

We ask you to remember: *Don't live, or perhaps die, with an unsatisfactory condition, REPORT IT!*

# The Gray Hair Department

ELEVEN PERCENT of all Army aircraft accidents are the result of pilots running into objects which they do not see.

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***Lieutenant Colonel Harry L. Bush,*** *above, is the Director, Test Division, Board Nr. 6, CONARC. In 1940, he was commissioned in the Field Artillery through the Alabama Polytechnic Institute ROTC. He was called to active duty in August 1941 and has had continuous service since that date.*

*His flying career began in the Army Air Corps glider training program, but in 1942 he completed Army pilot training at Fort Sill. During the 2d Infantry Division maneuvers in upper Michigan in 1943, Colonel Bush was one of five Army pilots to test the L-4 with troops under severe winter conditions. Following the maneuvers, he went overseas with the 2d Division and served as DivArty Air Officer from 1943 to 1946, through the Normandy, Northern France, Rhineland, Ard-Alsace, and Central Europe campaigns. After the Division's return to the States, he remained with it as Division Air Officer for a year.*

*Subsequent assignments in Colonel Bush's career included those of Sixth Army Air Officer and Army Aviation Logistics Officer for the National Guard Bureau. In 1952, he received a master of science degree in aeronautical engineering from Princeton University. For 2 years prior to his present assignment, he served as Chief Project Officer with Boards Nr. 1 and 5, CONARC, Army Aviation Division.*

*During 3,100 hours of pilot time, Colonel Bush has become a rated instrument pilot and is qualified in all Army fixed- and rotary-wing aircraft.*
*—The Editor*

Why? Simply because pilots are not looking in the right place at the right time. This is the obvious answer, yet it does not explain *why* these pilots are not looking in the right place.

The *situation* appears to be the basis for "running into unseen objects." The collision accident generally happens when a pilot has his aircraft in an unusual or marginal type situation. When a pilot encounters such a situation, he is subject to err for two reasons. First, if it is not a situation to which he is accustomed, his reactions on the controls are slow. Second, in marginal type situations, the allowance for error is greatly reduced, necessitating better judgment and faster response on the controls. Therefore, the key to solving the problem is to reduce the number of unusual or marginal type situations. This can be done in two ways. First, by reducing the situation to that of a normal one through training. For example, initial operations in confined areas mean a marginal type situation for the helicopter student pilot; but, as he continues his training, develops his judgment and coordination, and learns basic principles to be employed in such operations, the situation changes from the unusual to a normal one and becomes much less marginal. The second means of eliminating such situations would be to restrict the operations of the aircraft. This solution is undesirable insofar as it involves a reduction in aircraft utility.

The following accidents, taken from the file of the Army Aviation Safety Board, are typical of accidents in the "ran into unobserved objects" category and illustrate the type of *situations* in which such accidents are likely to occur.

### *Low-Level Flying*

While flying his L-19 on a floursack bombing mission, a pilot made four passes at a truck convoy then prepared to make a strafing run, the final part of the mission.

As the trucks approached the hill, the pilot came in low from the opposite side, flying with the contours of the terrain. Suddenly he felt a jolt in the aircraft and saw sparks. He immediately added full throttle and at the same time noticed the falling high tension wires which he had just struck.

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***The Gray Hair Department** is prepared by the ARMY AVIATION DIGEST staff with information obtained from the files of the Army Aviation Safety Board. The views expressed in this department are not necessarily those of the Department of the Army or of the Army Aviation School.—The Editor*

The pilot and his passenger inspected the plane from inside the cockpit and discovered that the right gear was missing. The pilot checked the controls and flight characteristics of the airplane and decided that the missing gear was the only damage. He made an excellent one-wheel emergency landing at the home airstrip, but even so, damages were $4,600.

Collisions with power lines usually produce spectacular fireworks, and it is obvious that no pilot would intentionally run the risks involved. Why did this pilot not see the power line? There possibly were several reasons, but only two of them will be considered here. Low level flight is always a marginal situation, and so much so that numerous regulatory restrictions have been issued against the practice. Experience has shown that there is a trap involved in contour flying which some aviators have not noticed. In flight, consciously or unconsciously, the pilot clears himself with reference to the horizon. If he can see the horizon he knows that his eye level is above objects in his path, and he can gauge comparative altitude. In low level flight the horizon is hidden and the pilot does not have an accurate reference line. The power line which stands out clearly against the sky when we are on the ground may be obscured against hills, trees, or buildings. As in this reported case, the pilot may not see the power line until the collision occurs.

The second factor which can be inferred in this and many other similar cases has to do with mission enthusiasm. Every Army aviator urgently wants every mission to be a success. When the mission involves a temporary release from a strict flying prohibition, the enthusiasm and the release are likely to induce a certain degree of exhiliration which may encourage the pilot to exceed his usual limits of precaution. This is a mental attitude which should be recognized, and taken into account.

What is the answer? The mission is the important thing, but the dangers should be greatly reduced by planning, by careful aerial and ground reconnaissance, and by rehearsals. The aviator should determine the safe limits before he undertakes the actual mission.

### *Confined Area Operation*

Moving a helicopter around in a confined area is difficult and a pilot must, in addition to adhering to all rules for such operations, be extremely careful. On the high reconnaissance, and even during the low reconnaissance, all the detail of an area cannot be ascer-

tained. Therefore, the pilot must be especially alert when flying the final approach, looking for tree branches, bush, wires, and other obstructions which might have been invisible from higher altitudes. After his approach terminates in a hover, the pilot must again survey the area before moving because, during the approach, the pilot's attention is on the approach path and he does not have time to note *all* the objects within the area even if he can see them. A movement from the hovering point should not be made until the pilot has completely cleared himself.

In this accident, an H-25 pilot was flying his helicopter during a rehearsal for a tactical demonstration. He flew over his area on a high reconnaissance, then lined up for the approach. The approach was made to the largest open area available and terminated in a hover. Because another H-25 was to follow his aircraft into the area, he had to move so the second aircraft could use the same landing area. To expedite his movement, the pilot hovered sideward to the left. The rotor blades were blowing a large amount of dust which restricted his visibility, but he continued hovering to the left, and then landed.

Upon leaving the helicopter, he noticed that he aft rotor blades were damaged. Investigation revealed that he had hovered too close to a clump of trees, and his aft rotor blades had struck the branches. Damage amounted to $3,891.

Why did not the pilot see the branches? Again, we could find many reasons, but the key to reduction of such accidents lies in the situation. Operating in a confined area, for an experienced pilot, is not an unusual situation, but it is a marginal type operation in which there is little room for error. In this instance, the pilot failed to adhere to principles which he had been taught concerning the particular type of operation. First, in his enthusiasm for satisfactory completion of the mission he got in a hurry in a marginal type situation. Second, in his rush, this pilot violated another rule by moving without properly clearing himself and, even after blowing dust greatly restricted his vision, he continued to move.

There is of course a supervisory element in the case. The purpose of a rehearsal is to make certain that all participants know their parts, that the plan is workable, and that the demonstration meets the requirements of the mission. It is fairly obvious that the collision was not anticipated, and the danger was not taken into consideration in the planning. The supervisor cannot guard against all of the mistakes his pilots might make, but he can try to make certain

that the requirements are not such as to put the aviators under pressures which tempt them to shortcut safe procedures. Presumably, this accident caused the supervisor to take steps against its happening again during the demonstration but that does not appear on the record. $3,891 is a sizable amount to pay for the oversight.

### *Conclusion*

When a situation is allowed to develop, either through supervisory or pilot error, in which the pilot fails to adhere to flight regulations and utilize his training, his chances of colliding with unseen objects are greatly increased. The solution is to reduce the unusual and marginal type situations to normal situations through training and supervision.

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### Metal Rotor Blades on H-13's and H-23's

Use of all-metal rotor blades on the H-13 and H-23 is likely in the near future. According to the Air Research and Development Command, successful flight and whirl-stand tests have been conducted on two experimental metal blades. One, designed and built by the Parsons Corp., is a steel spar blade in which the spar forms the leading edge of the blade with aluminum skins fastened to it to form the aft section. The other, produced by Bell Aircraft Corp., is a bonded metal blade. Bell officials say that H-13H helicopters, the first of which is scheduled for delivery in June 1956, will have all-metal rotor blades.

ARDC describes the metal blades as stronger, lighter, and more practical than wooden blades. Individual blades are interchangeable, making it possible to replace a single damaged blade without installing a new set of blades. Production and maintenance costs also will be reduced, according to ARDC.

# Straight and Level

**TO: *Editor-in-Chief***

The articles in the *Digest* have been good but all the articles seem to be strictly technical. Would it be possible to publish some material about the personnel and activities of various aviation units? In other words, information about who is where and what they are doing.

**FRANK LEONARD**
**1/Lt, Infantry**
**Alaska**

*Unfortunately we cannot publish personal news items or information on the transfer of Army aviators since regulations prohibit Army publications from duplicating each other. As for more information on the various units and their operations, we hope to include many more articles on unit operations in the 1956 issues and the* DIGEST *staff would appreciate receiving manuscripts or illustrations pertaining to Army aviation unit operations.—The Editor*

**TO: *Editor-in-Chief***

I enjoy reading your mag very much. I am an instructor in the Transportation School, Aviation Department, Fort Eustis, Va. I note that letters and suggestive criticism are welcome.

In the December issue, a Captain Teague expressed a desire for training information on A/C maintenance. He should contact his TAAM CO, which is responsible by regulations to instruct him on his problems. I happen to instruct the Army maintenance officer course and know that officer graduates should be able to furnish school material for him to become trained on the job. These two sources will also serve him as a source for on-the-job training (information) to raise the skill and knowledge level of his mechanics. . . . (If) I may be of further help, I would gladly oblige.

Now for a criticism. This last issue (December 1955) had two articles on the same subject, mountain flying. Two articles on the same subject in one issue is dull reading, but normally (with one per issue) educational and interesting.

. . . Finally, how about a column like "Old Timer" instead of Gray Hair? What about presenting educational flight experiences instead of accident reports, a positive approach?

Continue the advice on flying to include info on water, desert, plain, tropical, forest, and weather flying.

**W/O C. MACREA HULETT**
**Aviation Dept., Trans. School**
**Fort Eustis, Va.**

*The suggestion that flight experiences be reported in "The Gray Hair Department" is good. In the September 1955 issue of the* DIGEST, *Mr. William R. Gaines wrote an article titled "Incidents Which Prevent Accidents" explaining how an incident reporting system which is in effect at The Army Aviation Center is aiding in accident prevention. Pilots who were involved in near-accidents made a brief report on each such incident. With these reports the post safety director was able to correct hazardous conditions and make recommendations concerning the operation of aircraft which aided in preventing accidents or near-accidents. We would appreciate receiving reports on near-accidents for publication in "The Gray Hair Department" from all Army aviation units.—The Editor.*

***Letters of constructive criticism are welcomed by the ARMY AVIATION DIGEST. To appear in this column they must be signed.—The Editor.***

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